REMARKS

Claims 6-11, 13, 19-23, and 25 remain pending in the present application. Claims 1-5, and 14 have previously been cancelled, and Claims 12, 15-18, and 24 have been withdrawn from consideration. Although Claims 1-5 and 14 have been cancelled, the Outstanding Office Action states that these claims are rejected. Additionally, new Claim 25 is not addressed in the Outstanding Office Action. Otherwise, Claims 6-11, 13, and 19-23 stand rejected. The Examiner is respectfully requested to reconsider and withdraw the rejections in view of the remarks contained herein.

REJECTION UNDER 35 U.S.C. § 103

Claims 3-4, 6-8, and 19-23 stand rejected under 35 U.S.C. § 103(a) as being unpatentable over Brueckner et al. (DE019745966) in view of Haas et al. (U.S. Pat. No. 6,770,848). This rejection is respectfully traversed.

First of all, Claims 3-4 have previously been cancelled in the amendment filed on July 7, 2005. Therefore, the rejection of these claims is moot.

Claims 6-8 and 19-23 include a resistive layer that is both a heater element and a temperature sensor, wherein this dual-purpose resistive layer is connected to a two-wire controller through only two electrical lead wires. As described in detail below, neither Brueckner et al. nor Haas et al., either explicitly or inherently, teach or suggest the claimed invention and thus these claims cannot be obvious.

Brueckner et al.

The Outstanding Office Action relies upon an English abstract of a German publication, and based upon this limited information, incorrectly states that Brueckner et al. discloses an inherently thin film heater in which the resistive layer is a heater

element and a temperature sensor. However, Applicants have obtained a full English translation of Brueckner et al. (a courtesy copy of which is enclosed) only to discover that Brueckner et al., in fact, is not related to a heater whatsoever. Brueckner et al. is directed to a resistive layer for resistors, not for heaters. As such, there is no need for a temperature sensor, let alone a two-wire controller that controls power to a heater. In the absence of any disclosure of a heater element and a temperature sensor, Applicants submit that Brueckner et al. cannot expressly or inherently disclose a thin film heater in which the resistive layer is both a heater element and a temperature sensor.

Even more specifically, to achieve the "adjustable TKR" (TCR in English) of the resistor, Brueckner et al. adjusts the thickness of an oxide layer, (e.g., page 4, paragraph 1), during fabrication of the resistor. The resulting resistor has a fixed TCR after the desired thickness is achieved, wherein multiple resistors can be fabricated with different TCRs by adjusting the thickness of the respective oxide layers. Thus, even if Brueckner et al. were misconstrued to inherently teach a heater, the resistive layer does not have sufficient TCR characteristics to allow the layer to function as both a heater element and a temperature sensor. Additionally, Brueckner et al. discloses creating the resistive layer "without a base and/or cover layer" (See, e.g., page 1, paragraph 2), which teaches away from the use of a dielectric layer as included in the claims. Accordingly, Brueckner et al., alone or in combination with the cited references, cannot render claims 6-8 and 19-23 obvious.

With regard to the rejections based on inherency, it is the Applicant's understanding that the Examiner "must provide rationale or evidence tending to show

inherency." (MPEP 2112). Additionally, "In relying upon the theory of inherency, the examiner must provide a basis in fact and/or technical reasoning to reasonably support the determination that the allegedly inherent characteristic necessarily flows from the teachings of the applied prior art." *Ex parte Levy*, 17 USPQ 2d 1461, 1464 (Bd. Pat. App. & Inter. 1990). However, the Outstanding Office Action omits the required substantive reasoning in favor of a "blanket" statement that an adjustable TCR layer for a resistor is a resistive layer that is a heater element and a temperature sensor. This statement is wholly void of any technical reasoning. Therefore, Applicants respectfully submit that the inherency argument is not properly supported by the Outstanding Office Action, and in light of the arguments submitted herein, respectfully request either further technical reasoning or withdrawal of the outstanding claim rejections based on inherency. Regardless, since Brueckner et al. is limited to a resistor and does not expressly relate to a heater, it does not (and cannot) inherently teach a resistive layer that is both a heater element and a temperature sensor. Therefore, the application of Brueckner et al. to the outstanding claims is improper and Applicants respectfully request withdrawal of the outstanding claim rejections based on this reference.

Haas et al.

Haas et al. does not disclose a two-wire controller as required in Claims 6-8 and 19-23. The controller of Haas et al. is connected to the heater element with two wires, however, the mere connection of a heater element to a controller with two wires is not a two-wire controller as defined in the present application. Referring to the detailed description at paragraph [0032], "the two-wire controller 14 determines the temperature of the layered heater 12 ...then sends signals to the power source 16 to control the

temperature of the layered heater 12 accordingly. Therefore, only a single set of electrical leads 18 is required rather than one set for the heater and one set for a temperature sensor."

More specifically, Haas et al. discloses a separate thermistor 22, which is a <u>separate sensor</u> that is used in conjunction with the controller to control temperature of the <u>separate</u> heater element. (See, e.g., Column 6, Lines 15-25). As a result, the thermistor requires thermistor wires 23 (Fig. 2, Column 7, Line 6), which renders the contoller of Haas et al. a four-wire controller, <u>not</u> a two-wire controller. Therefore, Haas et al. teaches away from the use of a two-wire controller with its use of a separate temperature sensor having a separate set of wires. Accordingly, without any teaching or suggestion of a resistive layer that is both a heater element and a temperature sensor, and which is connected to a two-wire controller through only two electrical lead wires, Haas et al. cannot be applied to render Claims 6-8 and 19-23 obvious. Therefore, Applicants respectfully request that the outstanding claim rejections be withdrawn.

<u>Claim 5</u>

Claim 5 is rejected under 35 U.S.C. §103(a) as being unpatentable over Brueckner et al. (DE019745966) in view of Haas et al. (U.S. Pat. No. 6,770,848) and further in view of Miyata et al. As previously stated, Claim 5 has been cancelled and thus the rejection of this claim is moot.

<u>Claims 9-10</u>

Claims 9-10 are rejected under 35 U.S.C. §103(a) as being unpatentable over Brueckner et al. (DE019745966) in view of Haas et al. (U.S. Pat. No. 6,770,848) and

further in view of Lumsden (U.S. Patent No. 6,489,742). Claims 9 and 10 depend from Claim 6 and distinguish over these references for at least the reasons stated above in connection with Claim 6. Therefore, Applicants respectfully request that these claim rejections be withdrawn.

Claim 13

Claim 13 is rejected under 35 U.S.C. §103(a) as being unpatentable over Brueckner et al. (DE019745966) in view of Haas et al. (U.S. Pat. No. 6,770,848) and further in view of Waggoner et al. Claim 13 depends from Claim 6 and distinguishes over these references for at least the reasons stated above in connection with Claim 6. Therefore, Applicants respectfully request that this claim rejection be withdrawn.

Claims 7-8

Claims 7-8 are rejected under 35 U.S.C. §103(a) as being unpatentable over Brueckner et al. (DE019745966) in view of Haas et al. (U.S. Pat. No. 6,770,848). Claims 7-8 depend from Claim 6 and distinguish over these references for at least the reasons stated above in connection with Claim 6. Therefore, Applicants respectfully request that these claim rejections also be withdrawn.

Claims 1-2 and 14

Claims 1-2 and 14 are rejected under 35 U.S.C. §103(a) as being unpatentable over Brueckner et al. (DE019745966) in view of Haas et al. (U.S. Pat. No. 6,770,848) and further in view of Hayashi. As previously stated, Claims 1-2 and 14 have been cancelled and thus the rejection of these claims is moot.

Finally, after multiple office actions, each having new grounds of rejection, a personal on-site interview with the Examiner, and the costs for translating a German language reference, Applicants are concerned that prosecution of the present application is not advancing. Therefore, Applicants have enclosed with this response a Notice of Appeal, which will be vigorously pursued in the absence of a Notice of Allowance.

CONCLUSION

It is believed that all of the stated grounds of objection have been properly traversed, accommodated, or rendered moot. Applicants therefore respectfully request that the Examiner reconsider and withdraw all presently outstanding objections. It is believed that a full and complete response has been made to the outstanding Office Action, and as such, the present application is in condition for allowance. Thus, prompt and favorable consideration of this amendment is respectfully requested. If the Examiner believes that personal communication will expedite prosecution of this application, the Examiner is invited to telephone the undersigned at (314) 726-7505.

Respectfully submitted,

Dated: 30 DECEMBER 2006

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Translation of DE 197 45 966 C1

Abstract

Low-resistance resistive layer

The invention relates to a low-resistance resistive layer with adjustable small temperature coefficient of the electric resistance (TKR).

It is the object of the invention to provide a low-resistance resistive layer on CuNi-basis, which, as single layer, i. e. without a base and/or cover layer from the system Ni and Cr, makes possible an adjustable small TKR.

According to the invention, the resistive layer consists of a CuNi-base-alloy which under avoidance of a base and/or cover layer is applied to a supporting body, wherein on the resistive layer an oxide layer is created. Via the oxide layer thickness the TKR can be adjusted. With increasing oxide layer thickness the TKR changes from negative values, as they are initially given after the layer separation, to positive values.

The layer can be applied to chips resistors and axial resistors, e. g..

Specification

The invention relates to the field of electrical engineering/electronic and relates to a low-resistance resistive layer with adjustable small temperature coefficient of the electric resistance (TKR). The layer can be applied to chips resistors and axial resistors, e. g.

Various alloys and layer systems for low-resistance resistive layers are known. NiCr-layers which are often used are suitable for surface resistances larger than 5 Ohm/q, not, however, for lower values. For this region low-resistance resistive layers on CuNi-basis are known as well (J. Nishino, Y. Ichinose, Y. Sorimachi and I. Tsubata, Int. Hybrid Microelectron, 8, 1, 5, 12 (1985).

Also known are low-resistance resistive layers on CuNi-basis with small fractions of transition metals, e. g. with 1% Mn (DD 292 340). The layers can be separated by sputtering onto an insulating substrate, e. g. onto aluminium oxide ceramic or oxidized Si-discs. The layers have a base and/or cover layer of NiCr.

For resistive layers which have to meet precision requirements a small TKR is necessary, wherein the TKR-value should be adjustable, in order to be able to adapt it to special use requirements or to be able to correct contact and other influences onto the TKR.

Generally, the TKR-adjustment is realized by a heat treatment distinctly above the maximal operation temperature. This heat

treatment is performed in inert or reducing atmosphere, e. g. in an anti-slag gas consisting of a nitrogen-hydrogen-mixture (DD 292 340).

Material science tests of Cu-NiMn-single layers of the composition $Cu_{57}Ni_{42}Mn_1$ (W. Brückner, St. Baunack, D. Elefant and G. Reiss, J. Appl. Phys., 79, page 8516 (1996) resulted in that with a heat treatment in anti-slag gas up to 550° C there is practically no change of the TKR and that it is only possible by means of the base and/or cover layer of NiCr to achieve a change of the TKR in case of a heat treatment. The TKR of the separated layer is negative, it changes to positive values by means of the heat treatment. This results in reactions between both partial layers NiCr and CuNi (Mn).

The disadvantage therein is that the low-resistance resistive layer material allows adjustment of a small TKR-value only in connection with NiCr-base and/or cover layers. The necessary separation of a layer system necessitates a large effort when applying layers.

It is the object of the invention to create a low-resistance resistive layer on CuNi-basis which, as single layer, i. e. without a base and/or cover layer from the system Ni and Cr, allows an adjustable small TKR.

This problem is solved by means of the resistive layer described in the patent claims.

The resistive layer according to the invention consists of a CuNi-base alloy which under avoidance of a base and/or cover

layer is applied to a supporting body, wherein on the resistive layer an oxide layer is created. By means of the oxide layer thickness the TKR can be adjusted. With increasing oxide layer thickness the TKR changes from negative values, as they are initially given after the layer separation, to positive values.

The CuNi-base alloy can contain 30 to 60 wt% Ni, 40 to 70 wt% Cu and a possible additive of at least up to 10 wt% of one or several transition metals. The layer can have been created from the alloy by means of sputtering onto the supporting body.

The oxide layer can have been formed by means of a heat treatment in the temperature range of 300 to 500° C in an oxidized atmosphere. As oxidized atmosphere air, an inert gas with oxygen or air addition or, as well, a technical inert gas with remaining oxygen can be used.

The thickness of the oxide layer can amount to 1% to 20% of the total layer thickness.

The advantage of the invention compared with the prior art is that only a single layer of a material on CuNi-basis has to be separated. This results, in contrast to a multi-layer separation with additional NiCr, in an improvement of the apparatus and of the technology, when a low-resistance layer with adjustable small TKR is required.

In the following the invention is explained in detail by means of an embodiment.

A CuNiMn-single layer of the composition $Cu_{59}Ni_{40}Mn_1$ is created on an oxidized silicon-substrate by sputtering. The created layer has a thickness of 410 nm, a surface resistance of 1,25 Ohm/q and a TKR-value of -54 ppm/K. After a heat treatment in Argon with an addition of 50 vol.-ppm air at 400°C during 0,5 h on the layer an oxide layer has formed from the layer material, having a thickness of ≈ 30 nm. The surface resistance is reduced by approximately 5%, the TKR-value is +5 ppm/K.

Claims

1. Low-resistance resistive layer with adjustable small temperature coefficient of the electric resistance TKR, **characterized in that** the resistive layer consists of a CuNi-base alloy, which under avoidance of a base and/or cover layer is applied to a supporting body, wherein on the resistive layer an oxide layer is created, the thickness of which determines the TKR.

2. Low-resistance resistive layer according to claim 1, characterized in that the CuNi-base alloy contains 30 to 60 wt% Ni, 40 to 70 wt% Cu and a possible addition of totally up to 10 wt% of one or several transition alloys.

3. Low-resistance resistive layer according to claim 1, characterized in that the CuNi-layer is created by means of sputtering on the supporting body.

4. Low-resistance resistive layer according to claim 1, characterized in that the oxide layer is formed by means of a heat treatment in the temperature range of 300 to 500° C in oxidized atmosphere.

5. Low-resistance resistive layer according to claim 1, characterized in that the thickness of the oxide layer amounts to 1% to 20% of the complete layer thickness.